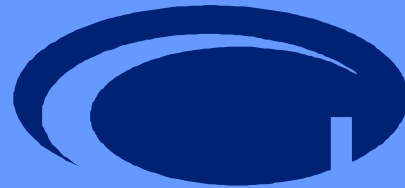


An Operations and Support Model for SEER-H



G A L O R A T H

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ISPA San Antonio

June 1999

Overview

The O&S Approach In SEER-H

How O&S Estimation Folds Into Knowledge Based Estimation

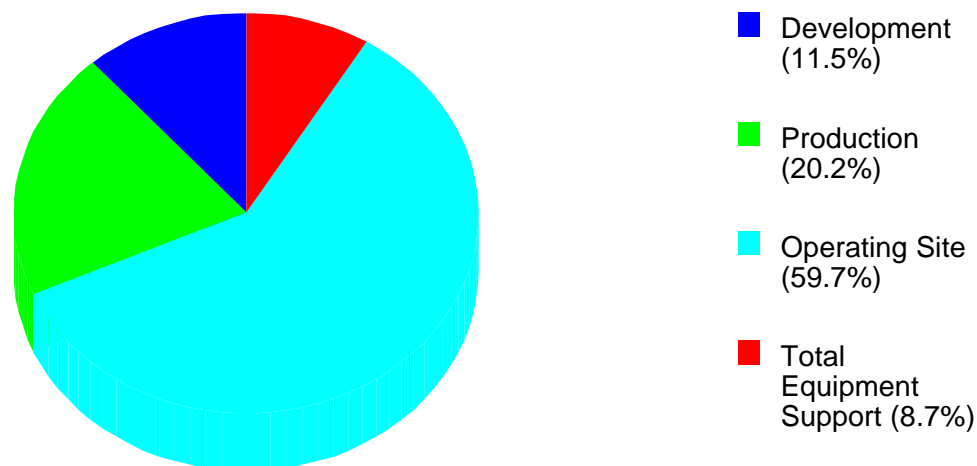
Describing O&S Scenarios



Full Integrated Life Cycle Costing

The SEER-H Operations & Support model is fully integrated with development and production estimates

FX-222 Estimate Baseline: Life Cycle Cost Allocation



A “Baseline” Flexible, Dynamic Model Allows Modeler To Set Assumptions

**Dynamic modeling of fielding,
maintenance, support**



Modeling Operations Cost

Concept Of Operations



Parameters - SITE: Long Haul Routes			
+ OPERATING SITE		YES	
- Number Of Like Sites		1	
- Initial Year Of Operation		2000	
- Years Of Operation		6	
+ OPERATIONS SCHEDULE		Systems Fielded & Retired By Year	
- Phase 1	1	20	0
- Phase 2	2	30	0
- Phase 3	3	50	0
- Phase 4	4	0	20
- Phase 5	5	0	30
- Phase 6	6	0	50
- Phase (Next)	0	0	0
- Utilization	Usage Rates	24.00%	33.00% 48.00%
- Operating Personnel Per Unit	1.00	1.00	1.00
- Additional Operating Personnel/Year	0.00	0.00	0.00
- Operator Hourly Rate	60.00	60.00	60.00
- Cost Per Operating Hour	0.00	0.00	0.00
- Cost Per Operating Year	0.00	0.00	0.00

Operations Cost & Personnel Requirements

Operational Hours

Operations Cost

Modeling Support Cost

Equipment Configuration



Support Concept

Parameters - MECH: Cargo Lift			
+ LEVEL 1 SUPPORT			
- Consumable Cost Per Repair	0.00	0.00	0.00
- In Place Repair Rate	0.01%	0.01%	0.01%
- Remove & Replace Time (hours)	1.50	3.00	6.00
- MTTR (hours)	0.00	0.00	0.00
- Condemnation Rate	1.00%	2.00%	3.00%
+ LEVEL 2 SUPPORT			
- Consumable Cost Per Repair	0.00	0.00	0.00
- <<MTTR (hours)>>	10.08	10.08	10.08
- Condemnation Rate	1.00%	1.00%	2.00%
+ LEVEL 3 SUPPORT			
- Consumable Cost Per Repair	0.00	0.00	0.00
- <<MTTR (hours)>>	10.08	10.08	10.08
- Condemnation Rate	1.00%	1.00%	2.00%
+ Level 3 Support Activity by Site			
- Regional Repair Contractor	100.00%		

Equipment Description

Parameters - MECH: Cargo Lift			
+ EQUIPMENT INFORMATION			
- Usage Rate	100.00%	100.00%	100.00%
- <<Mature MTBF (hours)>>	3,224	3,224	3,224
- Scheduled Maintenance Cycle (hours)	80	150	200
- <<Operating Hours to Mature MTBF>>	94	94	94
- Spares Availability		90.00%	
- Spares Lead Time (hours)	72	336	1,008
- <<Equipment Replacement Cost>>	1,830.22	1,830.22	1,830.22
- <<Equipment Material Cost>>	469.20	469.20	469.20
- Retirement Cost Per Unit	0.00	0.00	0.00
- Packing/Shipping Factor	1.10	1.20	1.30
+ Quantity By Operational Site			
- <<Short Haul Routes>>	1	0	
- <<Long Haul Routes>>	1	0	

Equipment Specific
Deployment

Reliability

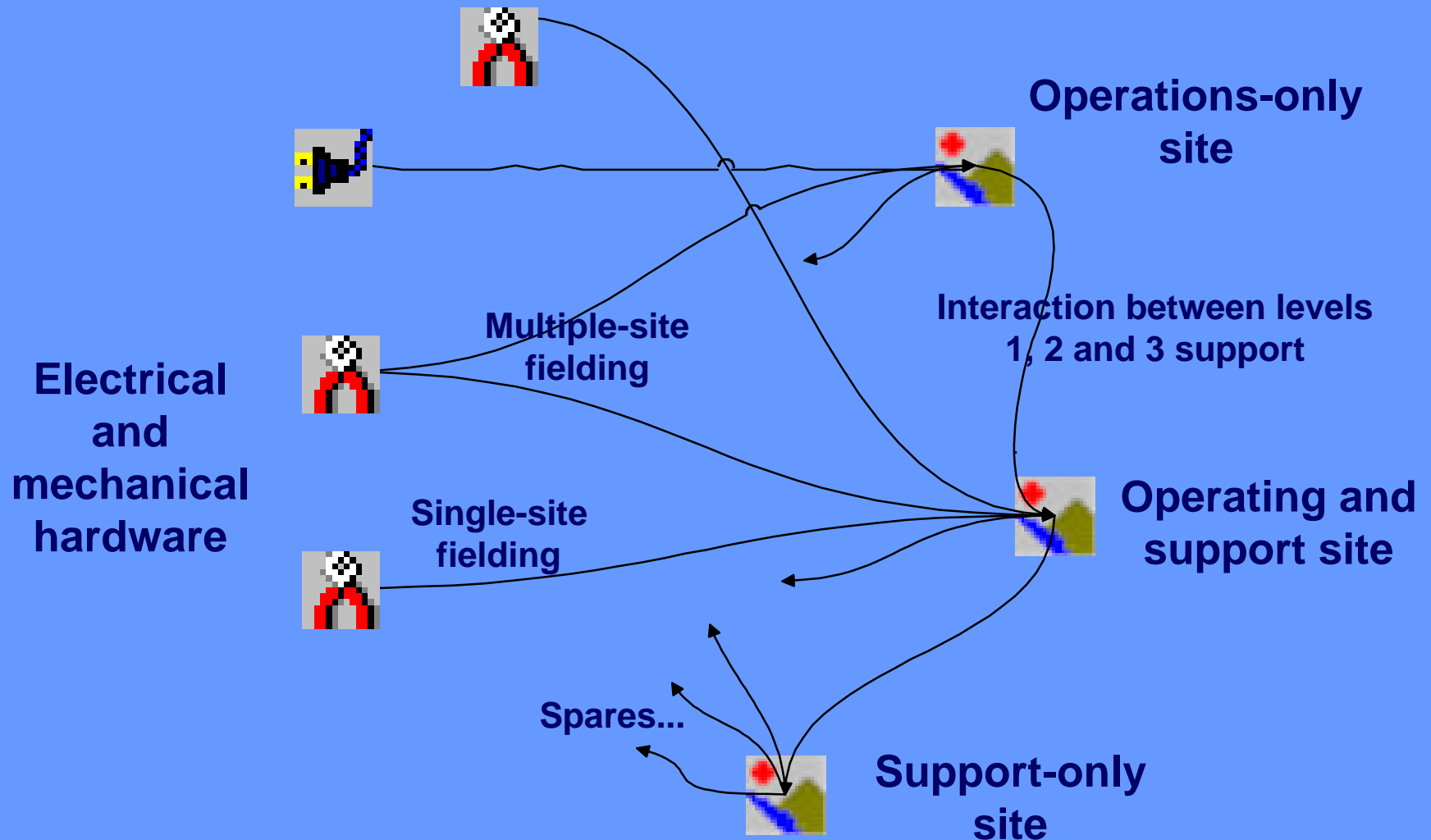
Support Cost

Maintenance
Demand Rate

Operational Hours

Maintenance Activity
by Level

O&S Model Concept of Operation: Interacting Hardware & Site Elements



More On The “Site” Element...

Capturing A Logical Rather Than Physical Entity

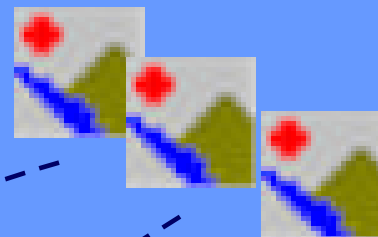
“Site” elements can be used to separately capture many distinguishing characteristics. They can be combined for a multi-faceted representation of the same physical location!

1 site element
for a single
“location”...



OR...

Many elements for
a single location...



All systems fielded at the site have uniform characteristics. An element can also represent many identical “sites”.

Equipment
use

Support arrangements
over time

At a particular site, you
can capture and isolate
differences in...

Specific components
of O&S costs

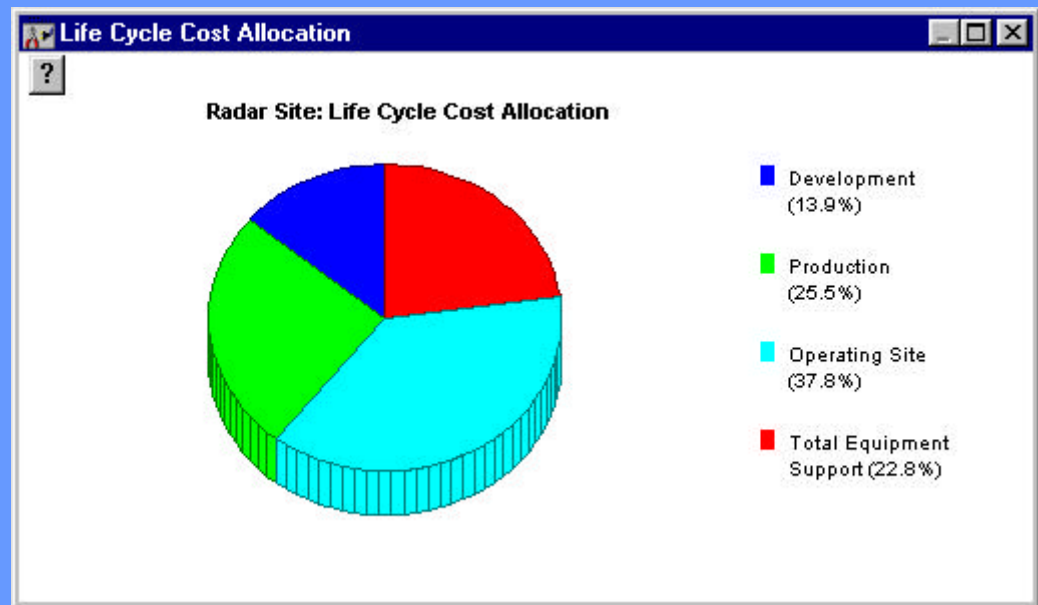


SEER-H with O&S Supports TOC

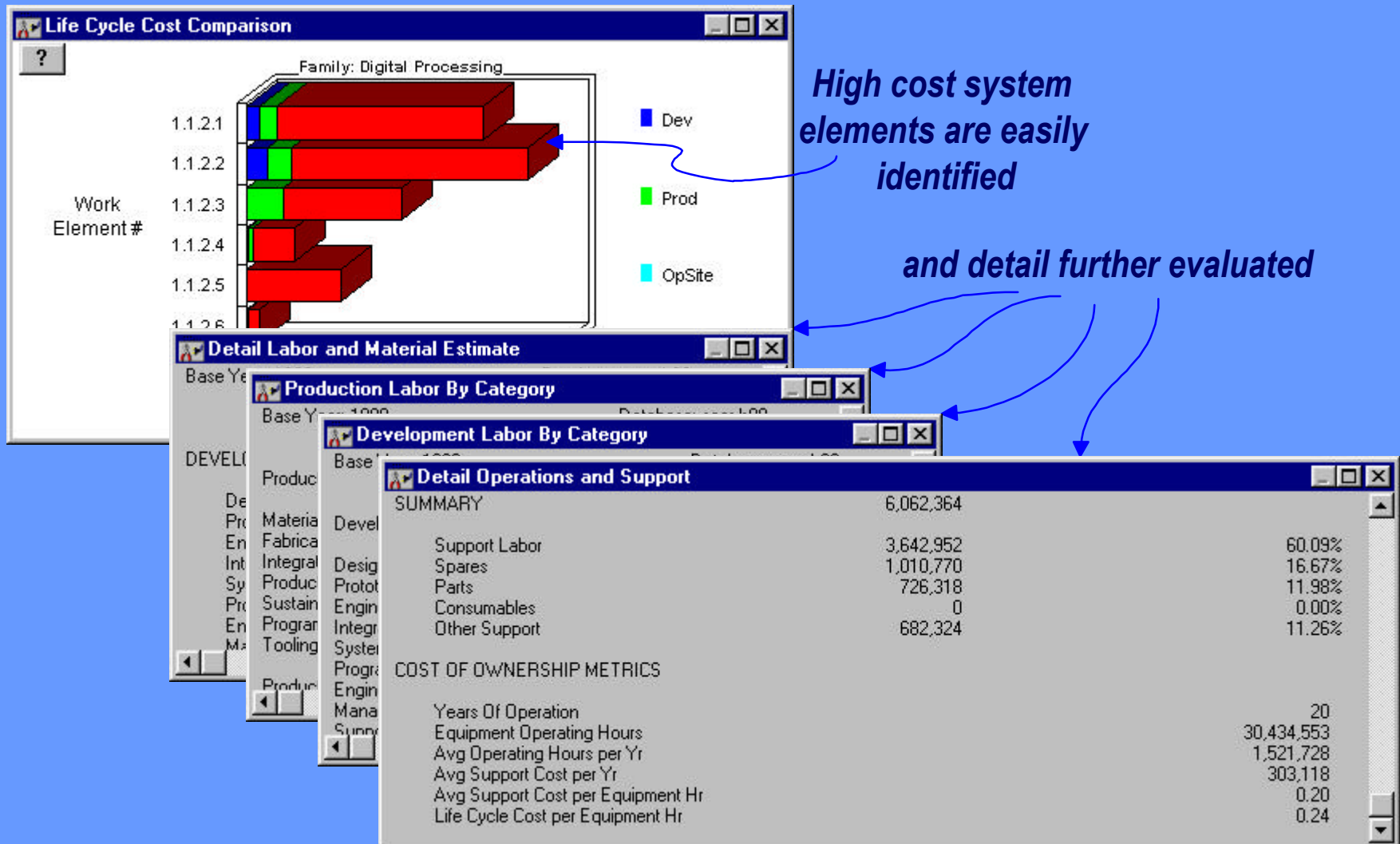
SEER-H TOC Is Based On 4 Major Cost Components...
Each Cost Component Possesses Its Own Drivers
All Components Are Interdependent

**Development Cost
+ Production Cost
+ Operations Cost
+ Support Cost**

Total Ownership Cost



Identifying Cost Drivers

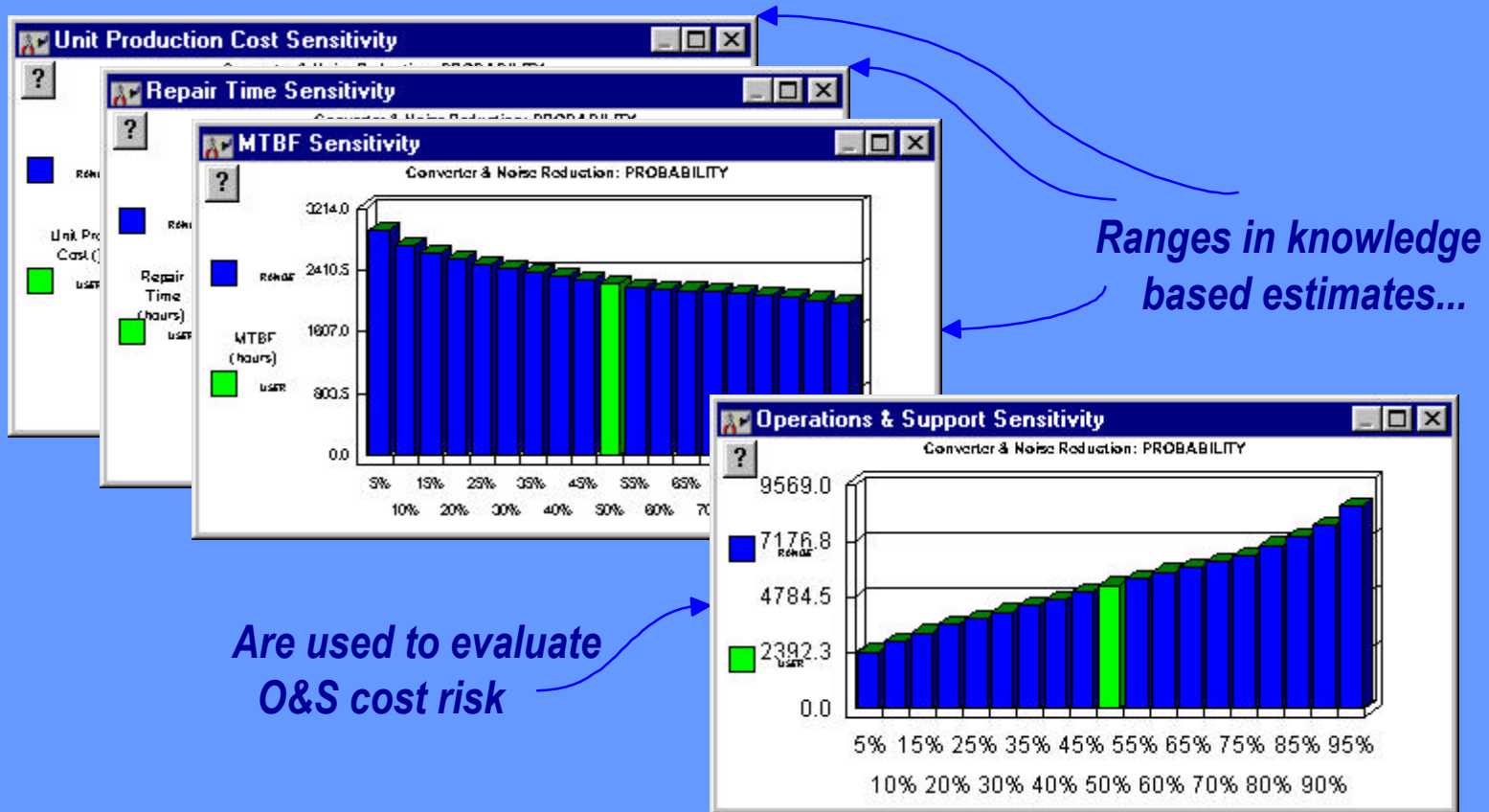


Knowledge-Based Approach

- **The core SEER-H O&S model uses traditional dynamic modeling techniques.**
- **Key drivers can be determined by knowledge base settings:**
 - Support cost drivers
 - MTBF, MTTR, Ophours To Maturity, Spares Cost, etc.
 - Operations & support characteristics
 - Usage Rates, Personnel Requirements, Labor Rates, etc.
- **Knowledge-based life-cycle cost estimates allow for:**
 - Life-cycle cost estimates at very early conceptual stages
 - Immediate TOC evaluation of design alternatives



Knowledge-Based Estimates Embody Risk



Example... Technology Upgrade of An Embedded Computer

Parameters - ELEC: Computer

+ PRODUCT DESCRIPTION			
- Total Printed Circuit Boards	1.00	3.00	4.00
+ CIRCUITRY COMPOSITION			
- Percent Analog	0.00%	0.00%	0.00%
- Percent Digital	80.00%	95.00%	100.00%
- Percent Hybrid	0.01%	5.00%	10.00%
- Discrete Components Per PCB	48	75	
- Surface Mount Discretes	00%	45.00%	
- Integrated Circuits Per PCB	30	40	
- Surface Mount ICs	25.00%	35.00%	40.00%
- Input/Output Pins Per PCB	95	230	300
- Clock Speed (MHz)	100.00	150.00	300.00
- Packaging Density	Nom	Nom	Nom+
- IC Technology	Nom+	Hi	Hi+
- Custom Chip Usage	Nom	Nom	Nom

Parameters - ELEC: Computer

+ PRODUCT DESCRIPTION			
- Total Printed Circuit Boards	1.00	1.00	2.00
+ CIRCUITRY COMPOSITION			
- Percent Analog	0.00%	0.00%	0.00%
- Percent Digital	80.00%	95.00%	100.00%
- Percent Hybrid	0.01%	5.00%	10.00%
- Discrete Components Per PCB	35	48	75
- Surface Mount Discretes	100.00%	100.00%	100.00%
- Integrated Circuits Per PCB	8	10	12
- Surface Mount ICs	00.00%	100.00%	100.00%
- Input/Output Pins Per PCB	120	120	120
- Clock Speed (MHz)	300.00	300.00	300.00
- Packaging Density	Hi-	Hi	Hi+
- IC Technology	VHi	VHi	VHi
- Custom Chip Usage	VHi	VHi	EHi-

Quick Estimate

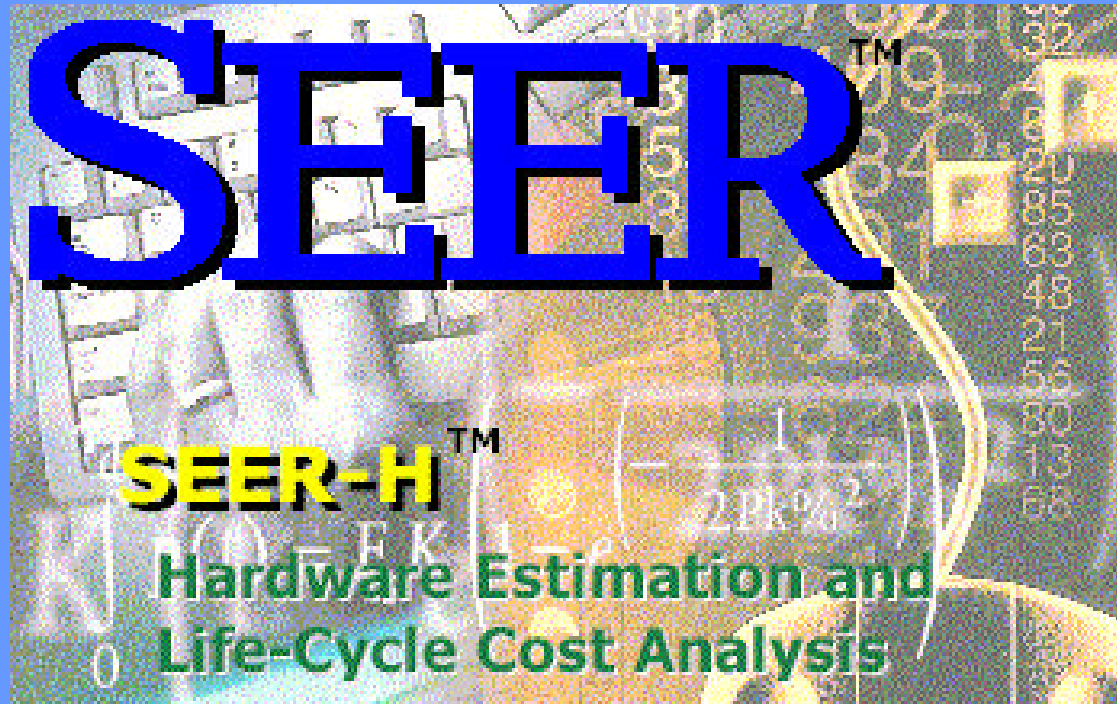
Base Year: 1998 Database: seer-1.0

	Result	Reference	
DEVELOPMENT			
Development Cost	455,886	354,595	29%
TOTAL PRODUCTION			
Production Cost	130,367	144,413	-9%
Total Production Units	25	25	0%
AVERAGE PRODUCTION UNIT COST (APUC)			
APUC	5,214.70	5,776.51	-9%
OTHER			
MTBF (Hours)	8,735	2,799	212%
Life Cycle Cost (Cost of Ownership)	794,549	751,643	6%
OPERATIONS & SUPPORT			
Total Equipment Support Cost	208,296	252,635	-17%
Support Labor Hours	1,362	2,602	-47%
Support Labor Cost	57,034	108,376	-46%
Other Support Cost	9,980	21,251	-52%
Spares	6	7	-13%
Spares Cost	31,288	40,436	-22%
Parts and Consumable Cost	109,994	82,573	33%
Equipment Operating Hours	922,603	922,603	0%

*Reduced component count
increased MTBF, reduced
support cost*

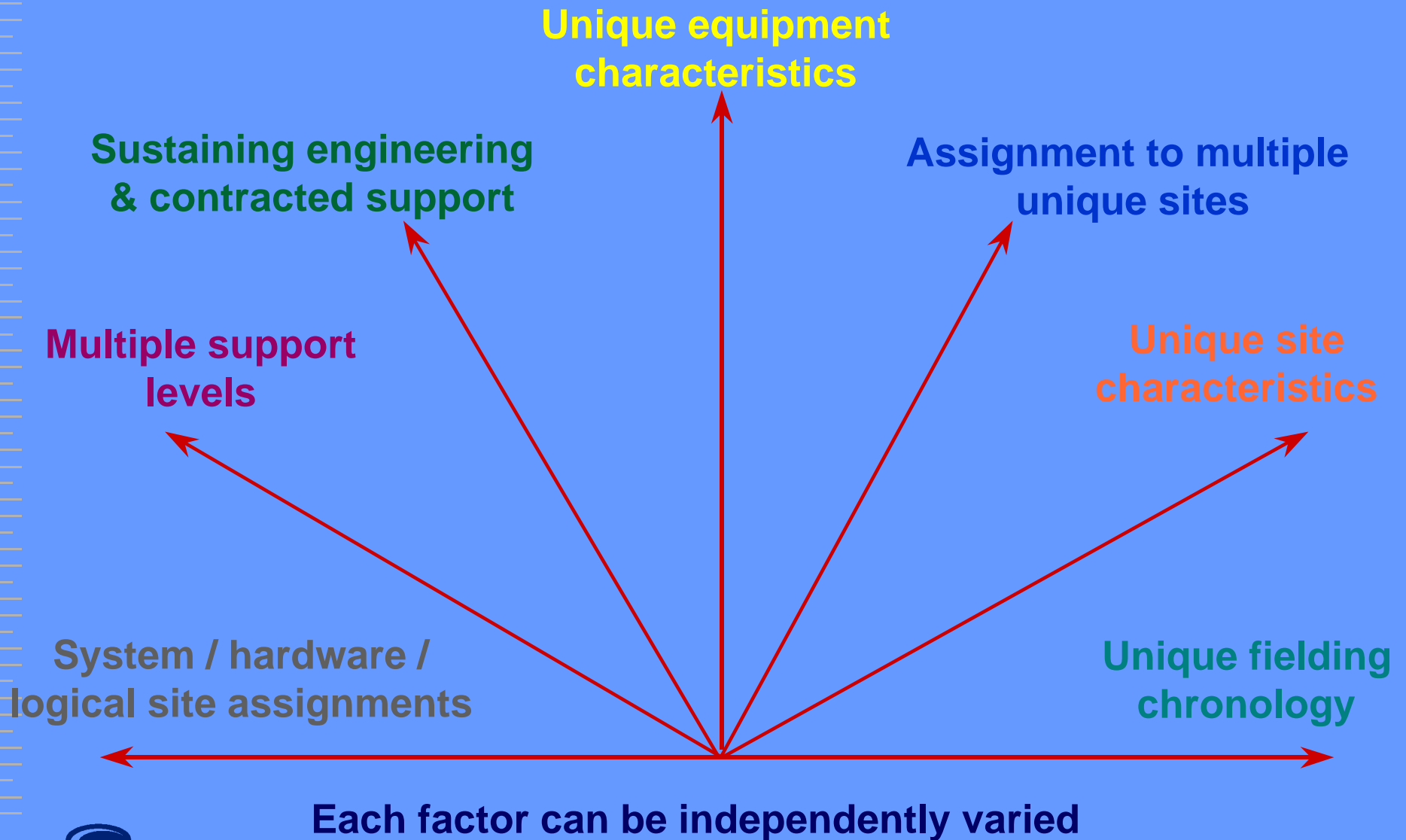
*Use of ASICs
increased NRE
and parts costs*

Demonstration of SEER-H With O&S Model



Please see Conference CD for a fully animated demonstration

Multiple Degrees of Freedom for Highly Flexible O&S Modeling

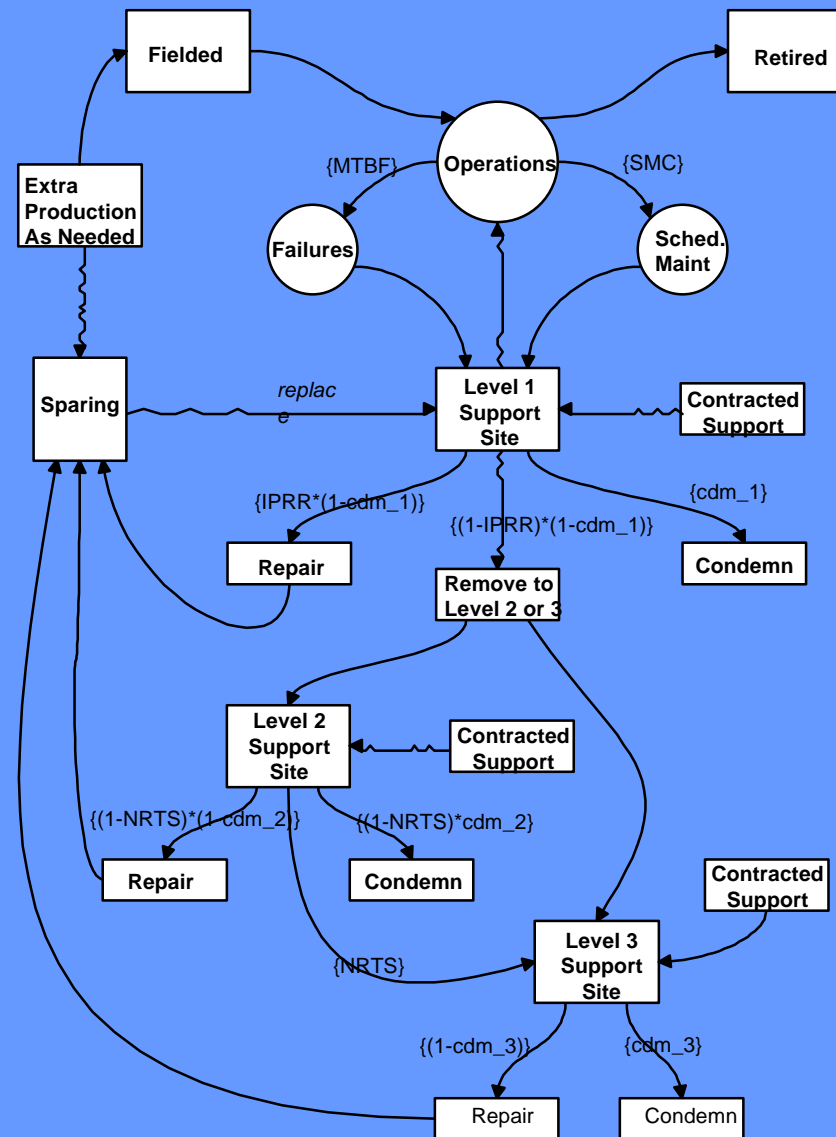


Sample Trade Studies

- ◆ What happens if the failure rate is decreased?
- ◆ Should a repair strategy be carried out at the system level, or should there be unique strategies for sub-components?
- ◆ How many tiers of maintenance should there be?
- ◆ Which sites should maintenance be focused at?
- ◆ What happens when fielding is accelerated?
- ◆ Can spares on hand be reduced at the outset of operations?
- ◆ How will changes in equipment utilization change costs?
- ◆ Can contracted support be substituted for organic support?



SEER-H O&S Modeling Flowchart



Thanks For Coming!

SEER-H - C:\Seer\H4-0\Newgen.har

File Edit Estimate Input Report Chart Options Window Help

Open Save Calc Now Insert Element Arrange Elements Set Ref Unit Note Calc

Work Elements

- 1 Σ NewGen Listening Station
 - 1.1 Σ Equipment Configuration
 - 1.1.1 Σ Receiver Module
 - 1.1.1.1 Receiver
 - 1.1.1.2 RF Module
 - 1.1.1.3 RF Machined Housing
 - 1.1.1.4 Rcv Chassis
 - 1.1.2 Σ Digital Processing
 - 1.1.2.1 Converter & Noise Reduction
 - 1.1.2.2 Data Processing
 - 1.1.2.3 Purchased Memory
 - 1.1.2.4 Data Bus
 - 1.1.2.5 Instrumentation Panel
 - 1.1.2.6 Digital Processing Chassis
 - 1.2 Σ Operational and Support Sites
 - 1.2.1 Northeast Auxiliary
 - 1.2.2 Atlantic Operations Center
 - 1.2.3 Western Operations Center
 - 1.2.4 Midwest Repairs
 - 1.2.5 Express Repair

Parameters - MECH: Digital Processing Chassis

+ PRODUCT DESCRIPTION

- Weight (lb)	18.00	18.00	22.00
- Volume (cubic feet)	4.00	4.00	4.00

+ MATERIAL COMPOSITION

- Percent Aluminum/Malleable Metal	100.00%	100.00%	100.00%
- Percent Steel Alloy	0.00%	0.00%	0.00%
- Percent Commrcl Available Exotic	0.00%	0.00%	0.00%
- Percent Other Exotic	0.00%	0.00%	0.00%
- Percent Composite	0.00%	0.00%	0.00%
- Percent Polymer	0.00%	0.00%	0.00%
- Percent Ceramic	0.00%	0.00%	0.00%
- Complexity of Form	Low-	Low	Nom
- Complexity of Fit	VLo	VLo	Low
- Construction Process	Nom	Hi	VHi

+ MISSION DESCRIPTION

- Operating Environment		Ground	
- Hardware Classification		Structural	
- Operating Service Life	50,000	60,000	100,000
- Internal Pressure (PSI)	0	0	0

+ PROGRAM DESCRIPTION

	70.00%	80.00%	100.00%
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Quick Estimate

Base Year: 1998 Database: seer-h99

Result

DEVELOPMENT	
Development Cost	50,194
TOTAL PRODUCTION	
Production Cost	19,385
Total Production Units	250
AVERAGE PRODUCTION UNIT COST (APUC)	
APUC	77.54
OPERATIONS & SUPPORT	
Total Equipment Support Cost	255,597

Life Cycle Cost Allocation

Digital Processing Chassis: Life Cycle Cost Allocation

Development	(15.4%)
Production	(6.0%)
Operating Site	(0.0%)
Total Equipment Support	(78.6%)